STUDENT STUDY PROJECT

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Submitted To Palamuru University As A Part Of Partial Accomplahment Of Bsc(Bzc) Degree

A STUDY ON THE SENSITIVITY OF INSECTS TO DIFFERENT TYPES OF LIGHT AT BAVAJIPALLY (VILL), THIMMAJIPET(MNDL), NAGARKURNOOL (DIST)

DEPARTMENT OF ZOOLOGY,

Dr.BRR Government College Jadcherla
Mahabubnagar-509001

(ACCREDITED BY NAAC WITH "B"" GRADE

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SUPERVISOR | HOD | PRINCIPAL

DEPT. OF ZOOLOGY
Dr. B.R.R. GOVT. COLLEGE
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A STUDY ON THE SENSITIVITY OF INSECTS TO DIFFERENT TYPES OF LIGHTS AT BAVAJIPALLY(Vill), TIMMAJIPET(Mndl), NAGARKURNOOL(Dist)

Project report submitted to the Palamuru university in partial fulfilment of the requirement for the award of the Degree

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DECLARATION

I. We S.Laxmi, M.Nandini, A.Bindhu, D.Shirisha, K.Srivani here by declare that this project report entitled

"A STUDY ON THE SENSITIVITY OF INSECTS TO DIFFERENT TYPES OF LIGHTS" Bavajipally (Vill) Thimmajipet (Mandel) Nagarkurnool (Dist) Telangana (State). is a genuine record of project work done by me under the guidance of. **"Smt.K.Subhashini"**, Assistant professor, Department of Zoology, **of Dr. Burgula RamaKrishna Rao Govt . Degree College, Jadcherla"** and has not been submitted to any University or Institution for the award of any Degree or Diploma.

I further declare that the results presented this work and considerations made there in, contribute in general to the advancement of knowledge in science.

Place: Bavajipally

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CERTIFICATE

This is to certify that the content of this project work entitled **"A STUDY ON THE SENSITIVITY OF INSECTS TO DIFFERENT TYPES OF LIGHTS"** at Bavajipally (vill) Thimmajipet (mandal) Nagarkurnool (dist) Telangana. is an authentic record of research work carried out by S.Laxmi (20033006445073), A.Bindhu (20033006445503), M.Nandini(20033006445050), D.Shirisha (20033006445021) , K.Srivani (20033006445034). as a part of the B.SC (B.Z.C) . project work during the year 2022-23 under my supervision and guidance at the Department of Zoology, **of Dr. Burgula RamaKrishna Rao Govt . Degree College, Jadcherla"**. I further certify that no part of the work has been presented for the award of any other Degree.

Place: BAVAJIPALLY
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ACKNOLEDGEMENTS

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CONTENTS

Chapter 1

INTRODUCTION

Anthropogenic light pollution is a growing global concern, currently affecting nearly 20% of the Earth's surface and increasing by approximately 6% per year (Holker *et al*, 2010). It may have serious consequences for humans, animals and plants.

Developed countries through their activities distributed over the entire geographical areas commonly results in Light pollution. Artificially lit areas are not limited to cities, but are generally associated with structures linked with urbanization, such as transportation networks, commercial and residential buildings and advertising spaces (Lacoeuilhe *et al*, 2014).

For hundreds of millions of years, the life on the earth has been dependent on daily cycle of light and dark rhythms and it governs life sustaining behaviors such as nourishment, reproduction, protection from predators and sleep.

Insects flying around a bulb, mistaking it for a moon, is the most well-known effect of light pollution and many insects perish before sunrise as they stuck in the orbit of such lights. Ecological light pollution has a major effect on the behavior and population of many organisms. These effects are caused by changes in direction as well as the attraction or repulsion of artificial light. Communication, reproduction, foraging, and migration can all be affected. (Longcore and Rich, 2004).

Artificial light at night (ALAN) is a major factor in global insect decline. Light pollution is the fastest growing potential threat to firefly conservation. ALAN acts both directly and indirectly (through sky glow) upon organisms. Basic responses and functions related to orientation in space in the form of phototaxis, phototropism and time in the form of circadian rhythms are affected by ALAN (Falcon *et al*, 2020).

Phototaxis is a type of innate behavioral response that takes place when an organism moves towards or away from a light source. The insects are attracted to light, and move towards it, are considered positively phototactic. The insects move away from light source are considered negatively phototactic. Their reactions are influenced by various characteristics of light, such as light exposure time, luminance intensity and light wavelength (Sambaraju and Phillips, 2008).

Different light sources attract different types and numbers of insects, and the spectral content of the light influences this to a great extent. Recent advances in external lighting technology, particularly the increasing adoption of broad spectrum 'white' LEDs suggest that impact of ALAN on natural systems are likely to increase.

The man-made light sends beams in all direction, insects can't keep the light at the right angle which causes insects to circle around the artificial light, which must confuse and frustrate them. Insects are sensitive to a broad-spectrum of light ranging from UV to red. The optical properties of their eyes are designed so that receptors make use of UV light (Smola and Meffert, 1975). Insects are capable of detecting UV and colours using photoreceptors. Different wavelengths of light vary in their attractiveness to insect families. Short-wavelength light, notably blue and violet, is the most appealing to insects. Insects are less attracted to yellow and red lights. Current commercial lamps designed to minimize insectattraction emit a non-white light, which restricts their use and illumination. Light emitting diode (LED) technology offers almost full control of the spectrum and polarization of the light emitted.

As insects are essential components of all terrestrial food webs, loss in their biomass is likely to have widespread ecological consequences. ALAN affects insects in unique ways related to their body size and visual system. The ability to discriminate between lights of different wavelengths depends on the possession of photo pigments with maximum sensitivity to light of different wavelengths (Hienton, 1974). Artificial light at night in combination with habitat loss, climate change, chemical pollution, invasion is driving insect declines. Hence the present work was undertaken to find the influence of different lights in insect attraction.

OBJECTIVES OF THE STUDY

1. Surveillance of species composition of insects to light during short time period.
2. Study of the influence of different lights to insect attraction.
3. Determine diversity of insect orders and their preferences for different wavelengths of light.
4. Study of the diversity of insects at BAVAJIPALLI

Chapter 2

REVIEW OF LITERATURE

Bertholf (1940) published a journal article in Beta biological society on the reaction in insects to light in which he summarized that the insects go towards or away from the source of illumination (positive or negative phototaxis). They may increase or decrease the rate of their general activity they may change their posture or move only part of the body. They may exhibit complicated conditional reflexes often apparently little related to the amount or kind of stimulation. According to the study of Dolley and White (1951), the phototactic reaction of insects can be modified or reversed by several factors such as temperature, moisture, food, and age. Adults of *syrphids* are attracted to light at temperature between 10^0 and 30^0 Celsius but move away from it at high temperatures. In behavioral studies conducted by Stremer (1959), Indian meal moths were most strongly attracted to UV (365 nm), suggesting that the eyes are potentially dichromatic. High-intensity light was more effective than low-intensity light in attracting moths.

Hamdorf *et. al.* (1971) studied the response of insect eye to ultraviolet light irradiation through behavioral and electrophysiological experiments. Smola and Meffert (1975) studied the optical properties of insects' eyes designed with receptors which make use of UV light. Study conducted by Baker and sadovy (1978) found the attraction of nocturnal moths to light is due to a shift in orientation response from moonlight to artificial light.

Stark and Tan (1982) in their study found that colour sensitivity in the UV spectrum plays a vital role in foraging, navigation, and mate selection in both flying and terrestrial invertebrate animals. This attraction to UV light has made insects a useful model for understanding visual sensitivity to UV light. According to Van Langevelde *et al* (2011), the degree to which insects are attracted to light is influenced by its intensity, polarization and the spectral composition of the light.

In the study conducted by McMunn and Hernandez (2018), the composition of temperate insect families active during diurnal, nocturnal and crepuscular hours has been shown to vary and both temperate and tropical insects exhibit size differences in diel activity.

Chapter 3

MATERIALS AND METHODS

STUDY AREA

This study was conducted at BAVAJIPALLY(vill),THIMMAJIPET(mandal) NAGARKURNOOL(dist). India situated in the central part of the TELANGANA (state). District is rich in varied landscape, which extends from the hills of Nallamala hills. This area has a subtropical dry climate with an oppressive hot season and seasonal rainfall.

The study was conducted in human habitats which served as largely homogenous habitats in which insect attraction could be attributed to light type.

STUDY PERIOD

The study was conducted during three-month time, started from march 2023 and ended in may 2023. Four collections were taken in each month and preserved separately. The study was carried at night from 7 p.m. to 8 p.m. In each collection the maximum number of insect specimens were collected. The observations were noted in field book and data sheet is prepared.

MATERIALS USED

Four different types of bulbs (LED, CFL, Incandescent bulb), forceps, fine brush,collection vials, plastic basins, white cloth as background and 70% diluted ethanol.

COLLECTION AND PRESERVATION

The study was conducted to assess the influence of different lights in insect's attraction. The insects were collected with the help of light trap using 15watt bulbs of different types.

In this study, light was suspended about 2.5m in height above the ground level in front of a white cloth background, giving flying insects a surface on which they can land. The ground perpendicular to the bulb was covered with rectangular plastic basins, with water in them so that the insects which try to rest on the ground can also be collected. The big insects from the area were collected using insect net and forceps. Insect light trap with incandescent bulb, compact fluorescent lamps (CFL), light-emitting diode (LED) were used for attracting the insects. These setups with different types of lights were placed a distance from one another with 10m.

From the same area four monthly samplings were carried out for each set of experiments. The insects collected in each sampling were sorted out family wise and the numbers were recorded. Also recorded temperature of each day. The insects were preserved in 70% alcohol and were brought to the laboratory for identification.

Species richness index was calculated using the formula: no of species/√no of insects.

Chapter 4

OBSERVATION AND RESULTS

A total of 4381 insects belonging to 10 orders were collected during the study period. Orthoptera, Isoptera, Hymenoptera, Coleoptera, Ephemeroptera, Lepidoptera, Diptera, Hemiptera, Neuroptera, Dermaptera are the identified orders. More number of insects got attracted Incandescent bulb light (1377). Less number was observed in LED light source (465). In all the light sources, Order Coleoptera and Lepidoptera is attracted in more numbers than others. Collection-wise February is the best month with more nocturnal insect activity.

Order	Month			Number of species	Total
	February	March	April		
Orthoptera	18	9	7	2	34
Isoptera	30	34	30	4	94
Hymenoptera	40	45	54	8	139
Coleoptera	110	98	99	13	307
Ephemeroptera	29	28	32	4	89
Lepidoptera	127	102	85	2	314
Diptera	79	62	70	1	211
Hemiptera	28	24	30	2	82
Neuroptera	37	32	28	1	97
Dermaptera	5	2	3	1	10
Total	503	436	438	38	1377

Table 1: Number of Insects attracted towards Incandescent bulb light

Order	Month			Number of species	Total
	February	March	April		
Orthoptera	9	6	3	4	18
Isoptera	57	54	48	2	159
Hymenoptera	45	24	22	5	91
Coleoptera	150	107	86	6	343
Ephemeroptera	27	16	9	1	52
Lepidoptera	80	34	20	7	134
Diptera	32	27	25	2	84
Hemiptera	42	30	27	2	99
Neuroptera	14	10	5	2	29
Dermaptera	1	0	1	1	2
Total	457	308	246	32	1011

Table 2: Number of Insects attracted towards Compact Fluorescent lamp (CFL)

Order	Month			Number of species	Total
	February	March	April		
Orthoptera	9	16	13	2	38
Isoptera	27	25	20	1	72
Hymenoptera	13	19	12	5	44
Coleoptera	32	27	25	6	84
Ephemeroptera	15	19	17	3	51
Lepidoptera	32	27	29	2	88
Diptera	17	17	16	2	50
Hemiptera	15	9	14	1	38
Neuroptera	0	0	0	0	0
Dermaptera	0	0	0	0	0
Total	160	159	146	22	465

Table 3: Number of Insects attracted towards LED

Order	Month			Number of species	Total
	February	March	April		
Orthoptera	9	16	13	2	38
Isoptera	27	25	20	1	72
Hymenoptera	13	19	12	5	44
Coleoptera	32	27	25	6	84
Ephemeroptera	15	19	17	3	51
Lepidoptera	32	27	29	2	88
Diptera	17	17	16	2	50
Hemiptera	15	9	14	1	38
Neuroptera	0	0	0	0	0
Dermaptera	0	0	0	0	0
Total	160	159	146	22	465

Table 3: Number of Insects attracted towards LED

Light used	Number of insects collected in different months			Total
	February	March	April	
Incandescent bulb	503	436	438	1377
CFL	457	308	246	1011
LED	160	159	146	465

Table 4: Consolidate accounts of Insects recorded during February to April

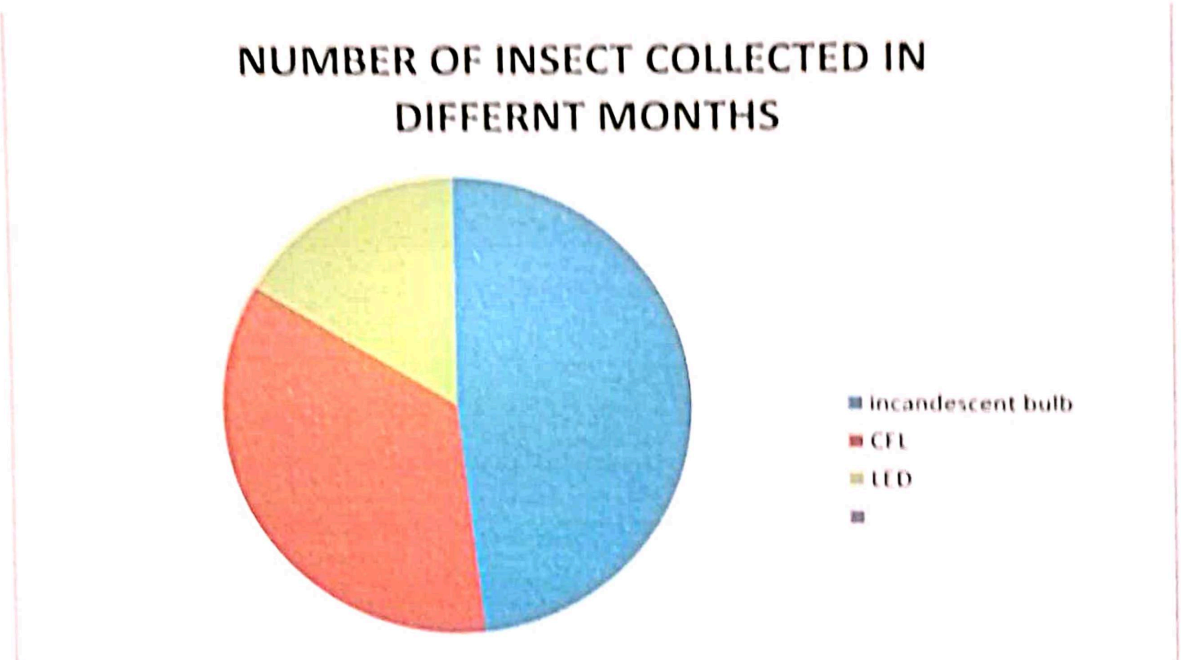

Fig.1: Graph showing the sensitivity of colour in insects' attraction

Light used	Number of Order	Number of Insects	Number of species	Species Richness Index	Percentage
Incandescent bulb	10	1377	38	1.02	31.43
CFL	10	1011	32	1.006	23.07
LED	8	465	22	1.02	10.61

Table 5: Consolidate accounts of Insects recorded from different colours of light

Light used	Incandescent bulb	CFL	LED
Species Richness Index	1.02	1.006	1.02

Table 6: Species Richness Index

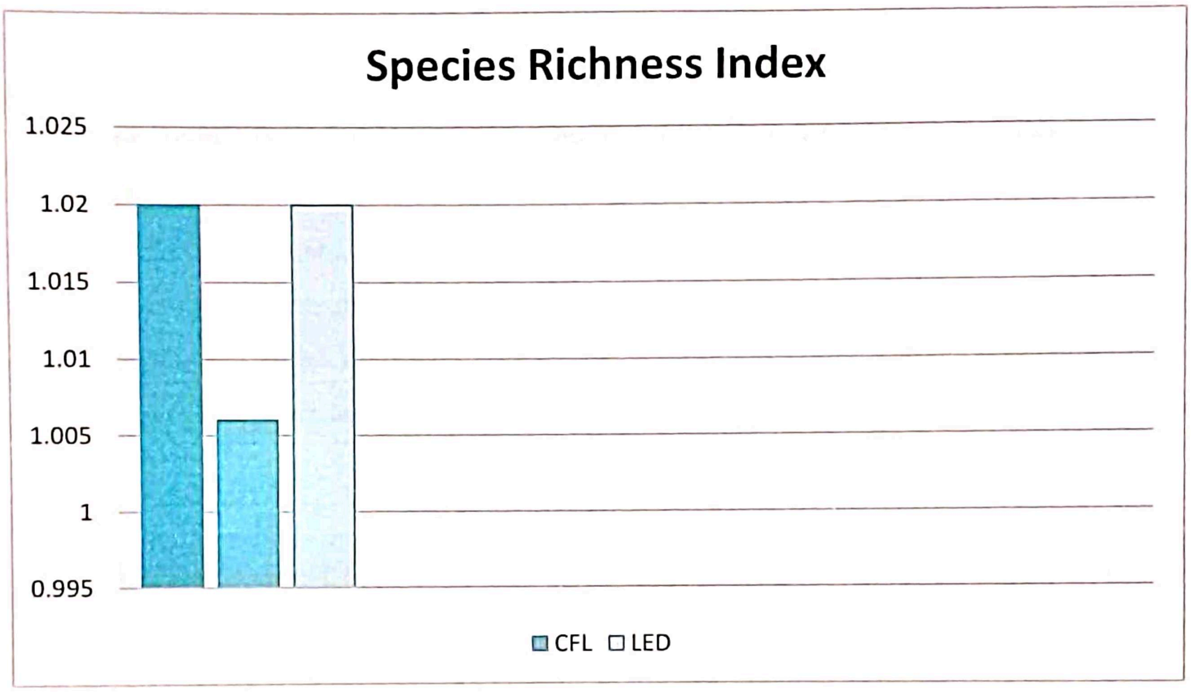

Fig. 2: Graph showing species richness index in various light sources

Species richness index is more incandescent bulb followed by the LED and CFL is having a low species richness index.

Chapter 5
DISCUSSION

This study aims to monitor the effect of different light sources on the insect diversity. Result outcome highlights the need for deciding the most appropriate lighting system in terms of ecological light pollution mitigation, depending on the particular groups of conservation interest inhabiting an area.

The purpose why conventional bulbs give off a lot of extra warmth has to do with they generate light. The electric current running through a filament that's made of tungsten produce light in incandescent bulbs. LEDs give off very little heat up to 41°C. That's really quite cool in comparison to Incandescent light and CFLs. Since LEDs use a diode in preference to a filament so they were using more energy to generate light than is being released as heat. In a CFL, an electric current is pushed through a tube containing argon and a small quantity of mercury vapor. CFLs use approximately 70% less energy than incandescent bulbs.

We discovered that LED had a significant effect on decreasing insect attraction to light compared with conventional discharge lamps used in street lighting. This reduction was fairly consistent among orders and families in the study area. Our findings agree with those of previous studies that have reported that LED lights did not cause attraction to moths (Lepidoptera) and attract less insects than mercury vapor light sources or incandescent technology (Van Grunsven *et al.*, 2019) The light spectral composition is not the only relevant parameter affecting the ecological light pollution levels. Furthermore, light may also range in intensity (the number of photons per unit area) and illumination (amount of light incident per unit area), which is dependent on the power. In fact, the attraction of insects to street lights is not only a function of light wavelength, but it is also a function of light intensity (Eisenbeis, 2006).

The insects collected in each sampling were sorted out in order wise and the numbers were recorded. Comparisons among the captured numbers by light traps suggested that and Lepidoptera orders are the most sensitive groups to ecological light pollution in the study area. In the present study, the collection of insects with the help of different lights confirmed that some insect orders are not attracted to certain types of light.

A total of 4381 insects belonging to 10 orders were collected during the study period. Maximum number of insects (1528) were attracted to incanndesteent and minimum number of insects attracted to LED (465). LED is widely turning into a preferred light source for street lighting because of its good lighting, good color perception, low energy consumption, and lengthy life. Compared to other conventional lighting systems, overall insect attraction to LED is considerably lower. Hence from the observation and outcomes, which revealed an important information on the impact of light sources on the insect diversity of the study area will certainly be beneficial for future researchers who focus their study on light pollution and its consequences.

Chapter 6
CONCLUSION

Widespread artificial illumination appreciably disrupts the activities of nocturnal and crepuscular groups of insects. The sensitivity of the insect eye relies upon various parameters and the intensity and colour of light source play a vital role in the reactions of insects.

The greater number of insects were collected in the month of MARCH (2023)and minimum in the month of MAY(2023). Such fluctuation in insect diversity of a particular study area may be due to the change in humidity and temperature. A statistical analysis of the daily capture indicates an expected significant reduction in Neuroptera, Dermaptera and Orthoptera.

The major objective of this study was to determine the different orders of insects and their differential preference to different wave length of light. The data indicates incandescent light is more attractive to the nocturnal insects (31.43%). The least attracted light is LED (10.6). The and CFL attracts insects 23.07% respectively.

We present a set of best practice recommendations to reduce artificial light pollution. LEDs and Compact Fluorescents (CFL) can help lessen energy use and protect the environment, however most effective warm- coloured bulbs should be used. Dimmers, motion sensors and timers can assist to lessen common illumination ranges and save more energy. Outdoor lighting fixtures that shield the light source to minimize glare and light trespass help to control light pollution. Turn off unnecessary indoor and outdoor light. Only purchase IDA approved light fixtures. Convince common people about the after effects of insects decline through light pollution.

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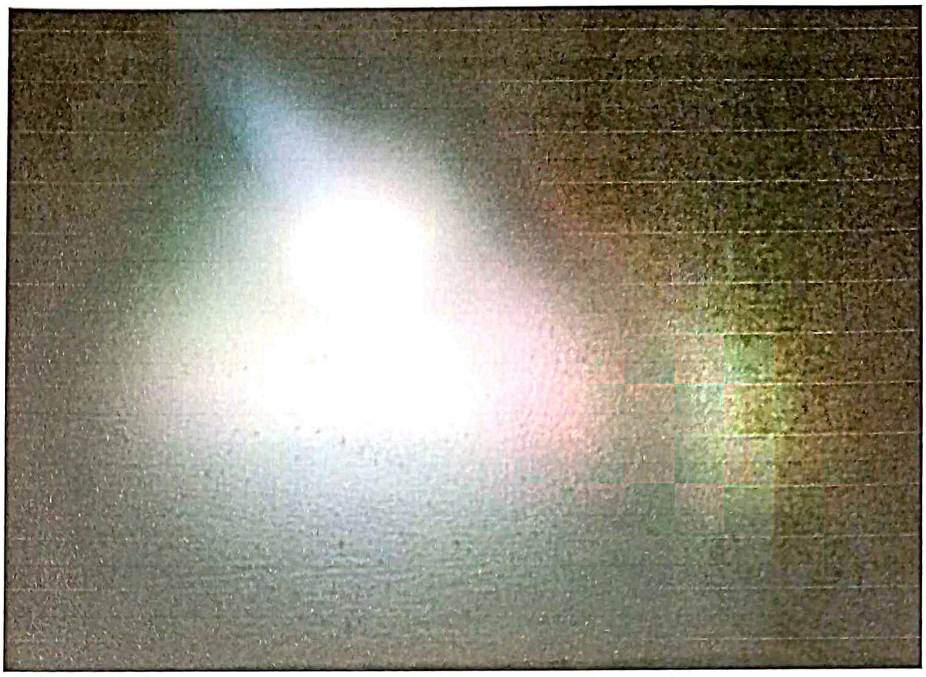
INSECT COLLECTION METHOD



INSECT ORDERS